



21 Mars 2016

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# Fast Optical Circuit Switch: An application of Photonics and 3D integration

# Optical photonics switch

## Three reasons for optical circuit switching

Power availability limits data center growth

30% of the Data center power and cost (Capex) is in the networking equipment

L2/L3 switches require multiple data copies and large memory buffers.

E/W communication growing

Need flexible bandwidth reallocation and fast network reconfiguration (switching time in the  $\mu\text{s}$  range)

Use cases:

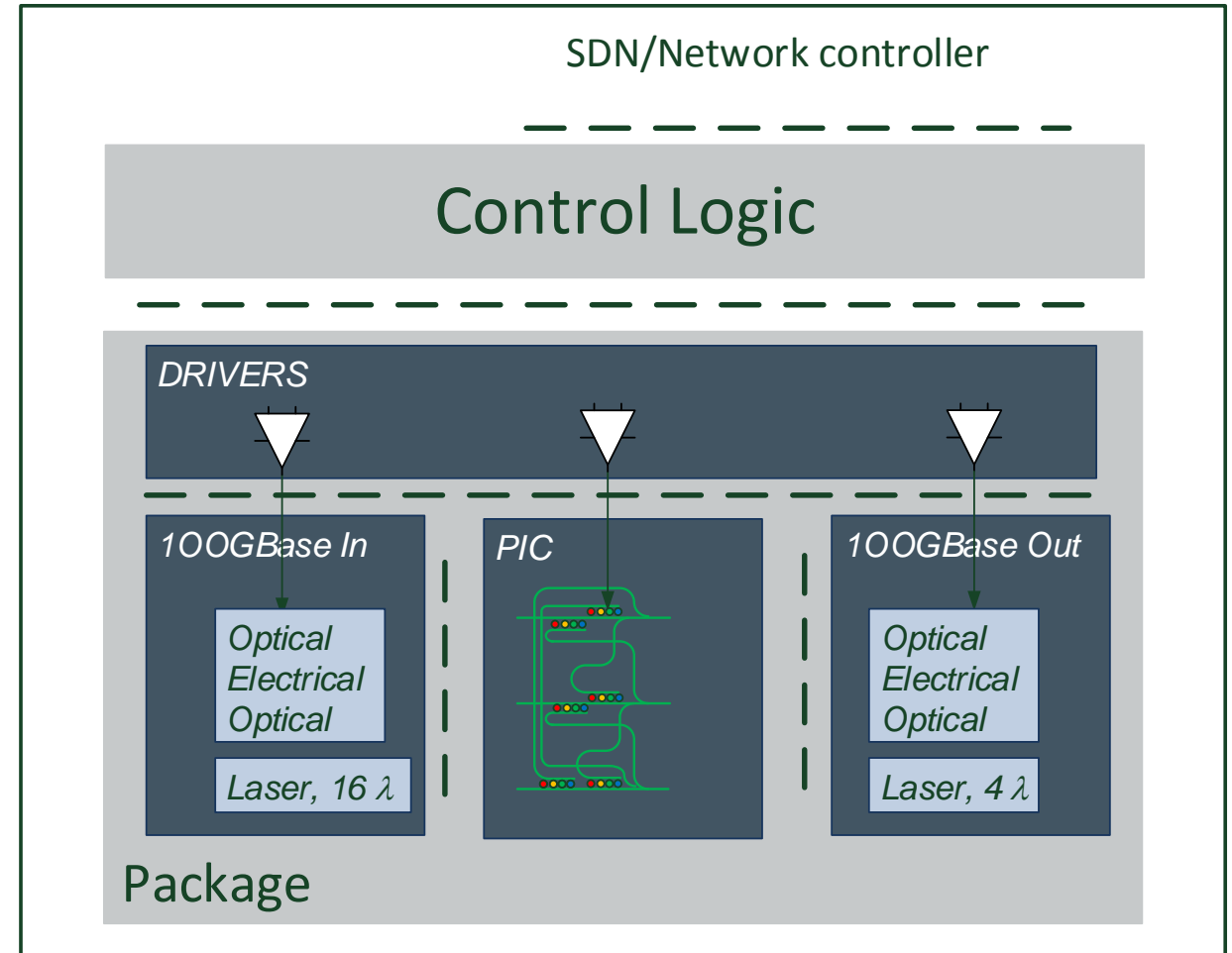
- Active connection panel
- Backup: allocate physical BW
- Virtual machine migration
- HPC checkpoint

# Switch architecture

- Objective is to develop a **12x12 or 24x24** switch matrix for 100Gbase connectivity.
- Based on **multi frequency** ring resonators.
- Circuit characteristics:
  - Full Photonic circuit switch (PIC)
  - Integrated 100GBase IO.
  - Integrated laser
  - Inter chip interfaces: electrical/optical

## 3D integration

- Several heterogeneous technologies:
  - Silicon photonics
  - Laser
  - electronics / PIC integration
- Bonding type
- Packaging



# First results of characterization

Test conditions:

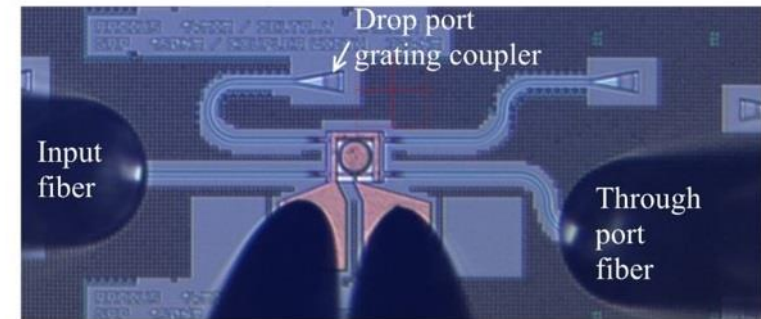
- 1310nm
- 20Gbps
- High Q ( $> 40000$ ) ring resonator
- P-i-N diode to control the frequency

Measurements:

Spectrum of the through port for different bias voltage,  
Q factor and resonance wavelength shift for different bias  
voltage

BER measurement for the PD, through port outside resonance  
and drop port at resonance.

80GHz spacing between frequencies is demonstrated.



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# Plans and evolution

Next steps: integration of all the switch components

- control electronics - Flip-chip bonding / chiplet
- embedded lasers technology selection (e.g. direct molecular bonding)
- Integration of the IO modules and packaging
- Integration of control logic

Large scale experimentation:

- power measurement
- integration with applications for higher efficiency.

Follow the evolution of networking standards:

- higher order modulation schemes (PAM...)
- Higher data rates



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**Thank you**